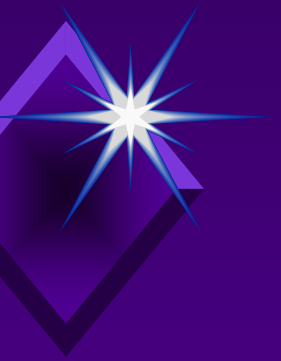


The Effects of On-Site Sewage Systems on Ground Water Quality

Melanie Kimsey

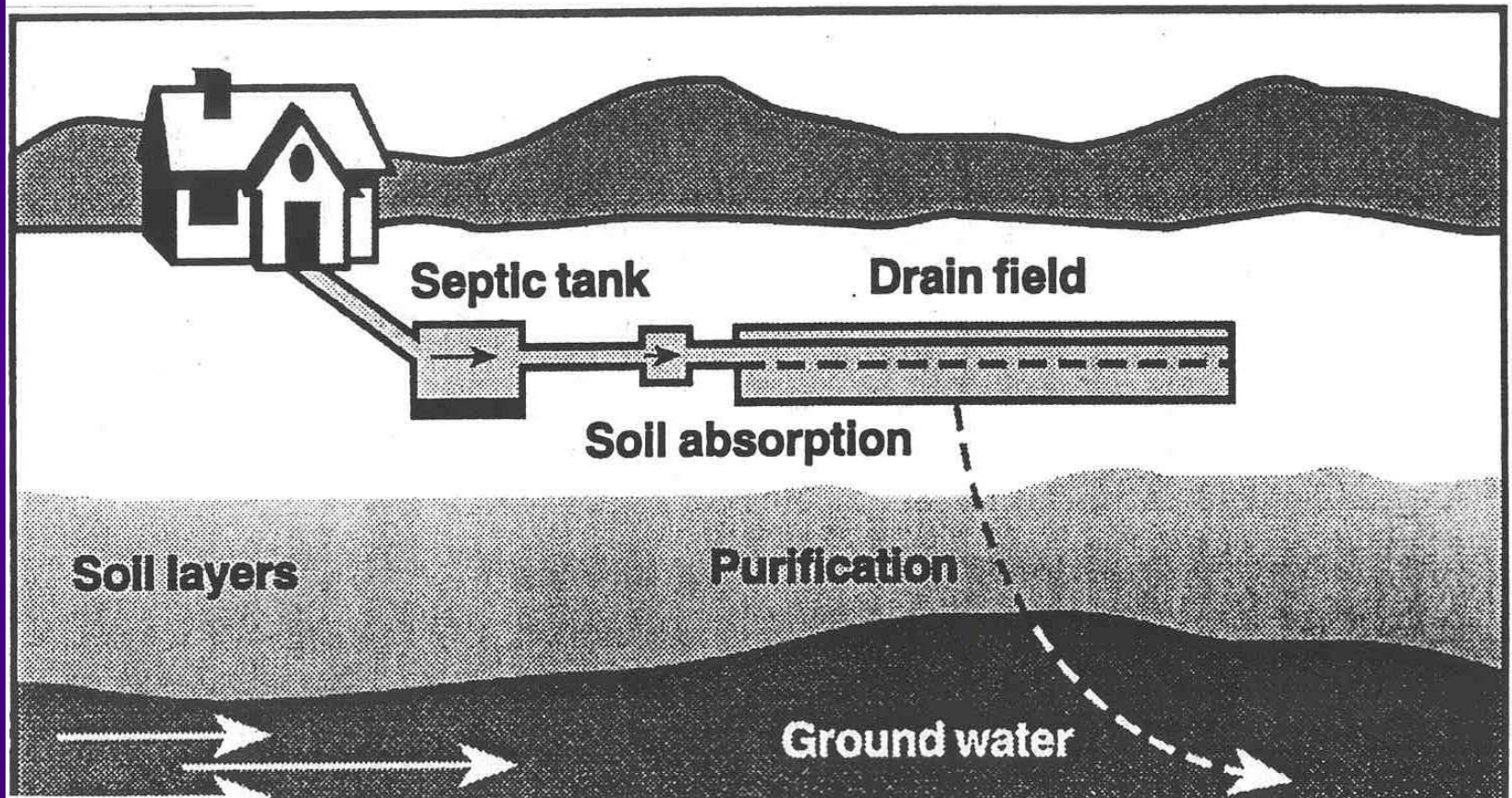
Washington State Department of Ecology
Water Quality Program
Southwest Regional Office

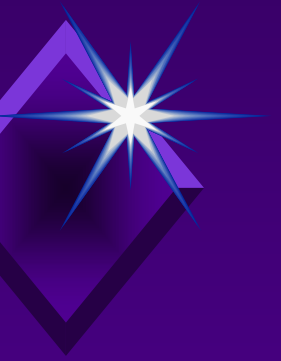


On-Site Sewage Systems

- ◆ One of the most effective means of treating and disposing of domestic wastewater
- ◆ Most prevalent source of ground water contamination
- ◆ Contributes the greatest volume of wastewater to ground water
- ◆ Most frequently reported sources of contamination

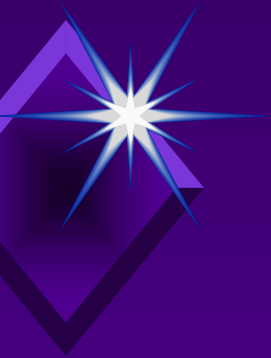
Conventional onsite wastewater treatment system





Nitrate

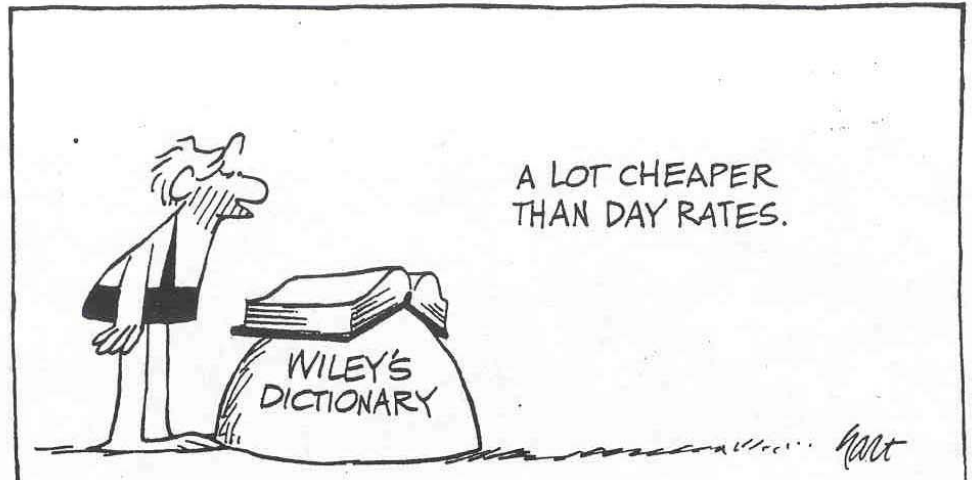
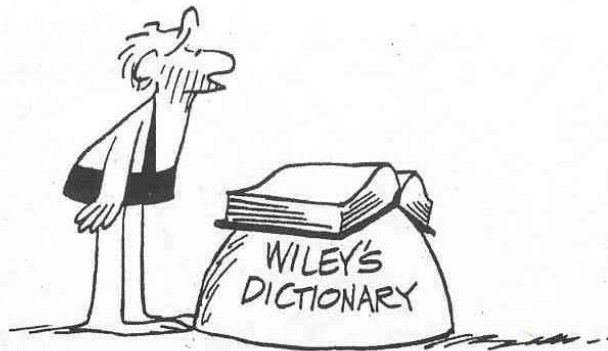
- ◆ Nitrate contamination of Washington State's aquifers is the most widespread problem
- ◆ Estimated 10-15% of drinking water supply wells exceed standard of 10 mg N/l
- ◆ Single domestic wells have higher risk of contamination

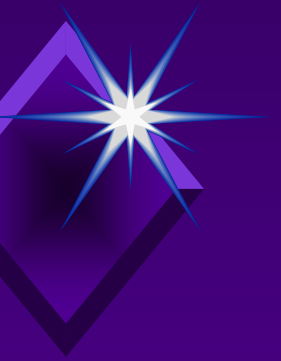


B.C.

By Johnny Hart

nitrates





Factors that Affect Ground Water Contamination:

- ◆ Density of households
- ◆ Contaminant loading
- ◆ Geology and soil type
- ◆ Hydrogeologic characteristics
- ◆ Ambient ground water quality
- ◆ Climate



Factors affecting ground water quality

- ◆ Mass Loading
 - ◆ Volume of wastewater
 - ◆ Number of people per household
 - ◆ Nitrogen mass
- ◆ Aquifer characteristics
 - ◆ Aquifer media
 - ◆ Hydraulic conductivity
 - ◆ Hydraulic gradient
 - ◆ Mixing zone boundaries



Evaluate the degree to which on-site sewage systems contribute to ground water quality degradation in various hydrogeologic environments

◆ Variable:

◆ Aquifer Material

◆ Constants:

◆ shallow aquifer

◆ climate

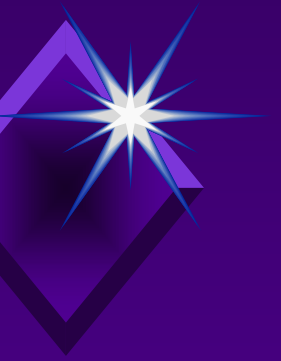
◆ type of OSS system

◆ wastewater loading

Study Design

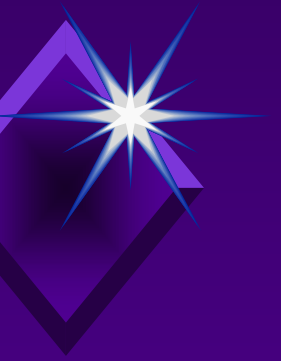
- ◆ 3 sites
 - ◆ 4 monitor wells
 - ◆ 1 upgradient
 - ◆ 3 downgradient
 - ◆ 2 lysimeters
 - ◆ effluent monitoring
- ◆ Quarterly monitoring for 2 years





Monitor Well Installation





Monitored Parameters

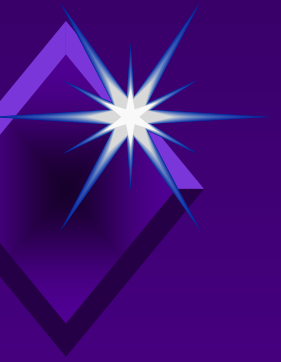
- ◆ Total Nitrogen
- ◆ Fecal Coliform Bacteria
- ◆ Metals
- ◆ Cations / Anions
- ◆ VOC's
- ◆ MBAS
- ◆ Field Parameters





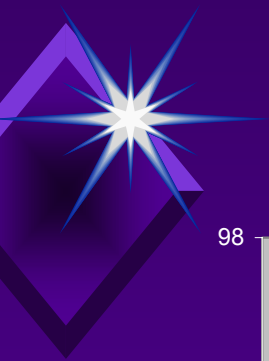
Domestic Wastewater Characteristics

- ◆ Total Nitrogen (43 mg/l)
- ◆ Chloride (57 mg/l)
- ◆ Lead (0.161 mg/l)
- ◆ Zinc (5.7 mg/l)
- ◆ Cadmium (0.007 mg/l)
- ◆ Mercury
- ◆ Total Phenol
- ◆ Total Benzene
- ◆ Toluene (32 ug/l)
- ◆ Chloroform (0.77 ug/l)
- ◆ Trichloroethylene
- ◆ Tetrachloroethylene
- ◆ Methylene Chloride
- ◆ 35 - 100 mg/l
- ◆ 30 - 100 mg/l
- ◆ 0.96 - 0.0065 mg/l
- ◆ 0.66 - 0.016 mg/l
- ◆ 0.007 - 0.00016 mg/l
- ◆ 0.0023 - 0.0002 mg/l
- ◆ 13 - 22 ug/l
- ◆ 2.3 - 2.4 ug/l
- ◆ 4.3 - 5.4 ug/l
- ◆ 0.7 - 5.3 ug/l
- ◆ 0 - 150 ug/l
- ◆ 2.6 - 100 ug/l
- ◆ 0 - 400 ug/l

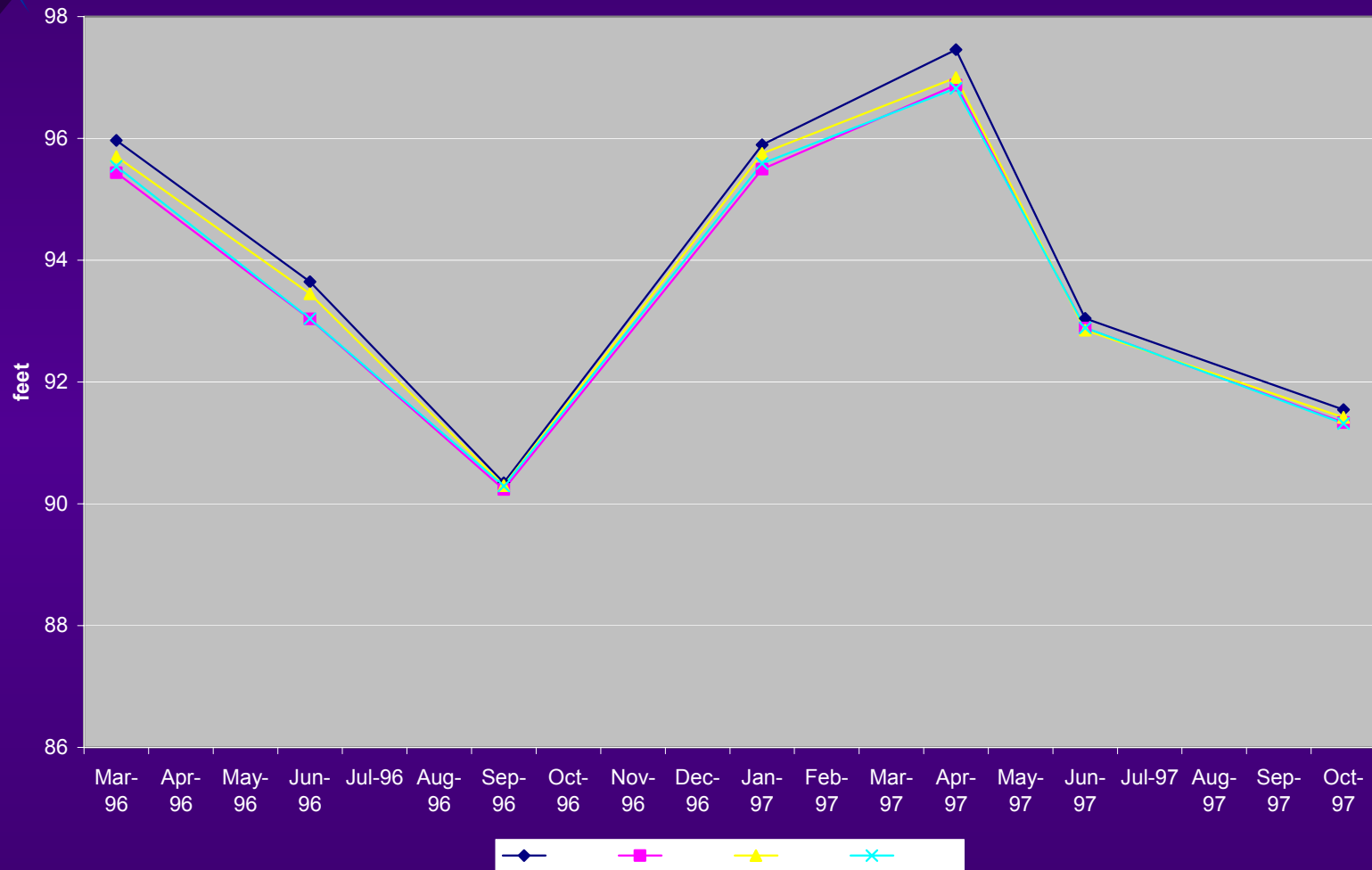


Site O

- ◆ Fine sand aquifer
- ◆ 1 acre lot
- ◆ 4 people/house
- ◆ no fertilizer use
- ◆ 50.8 in/yr precipitation

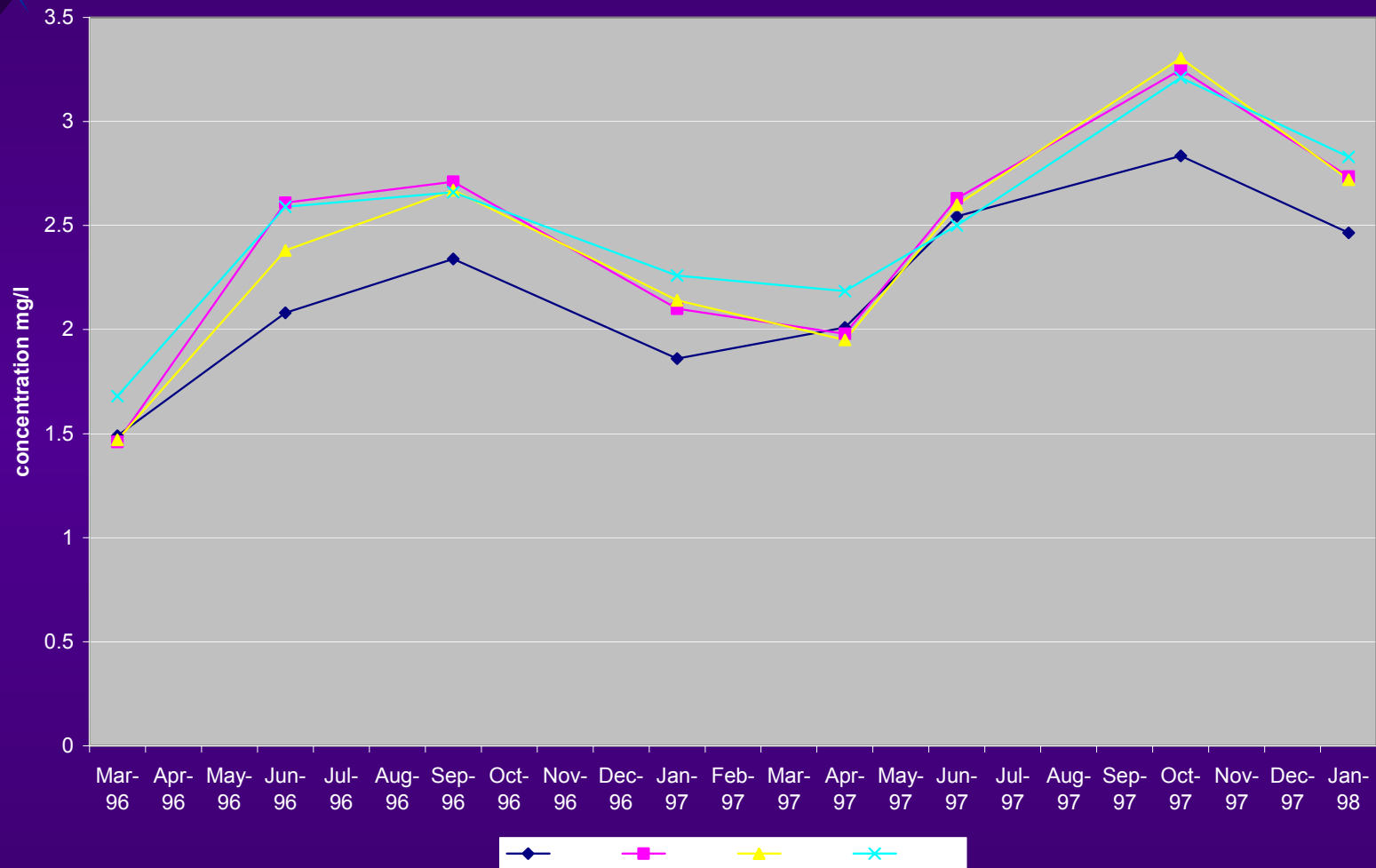


Site O -- Ground Water Elevation



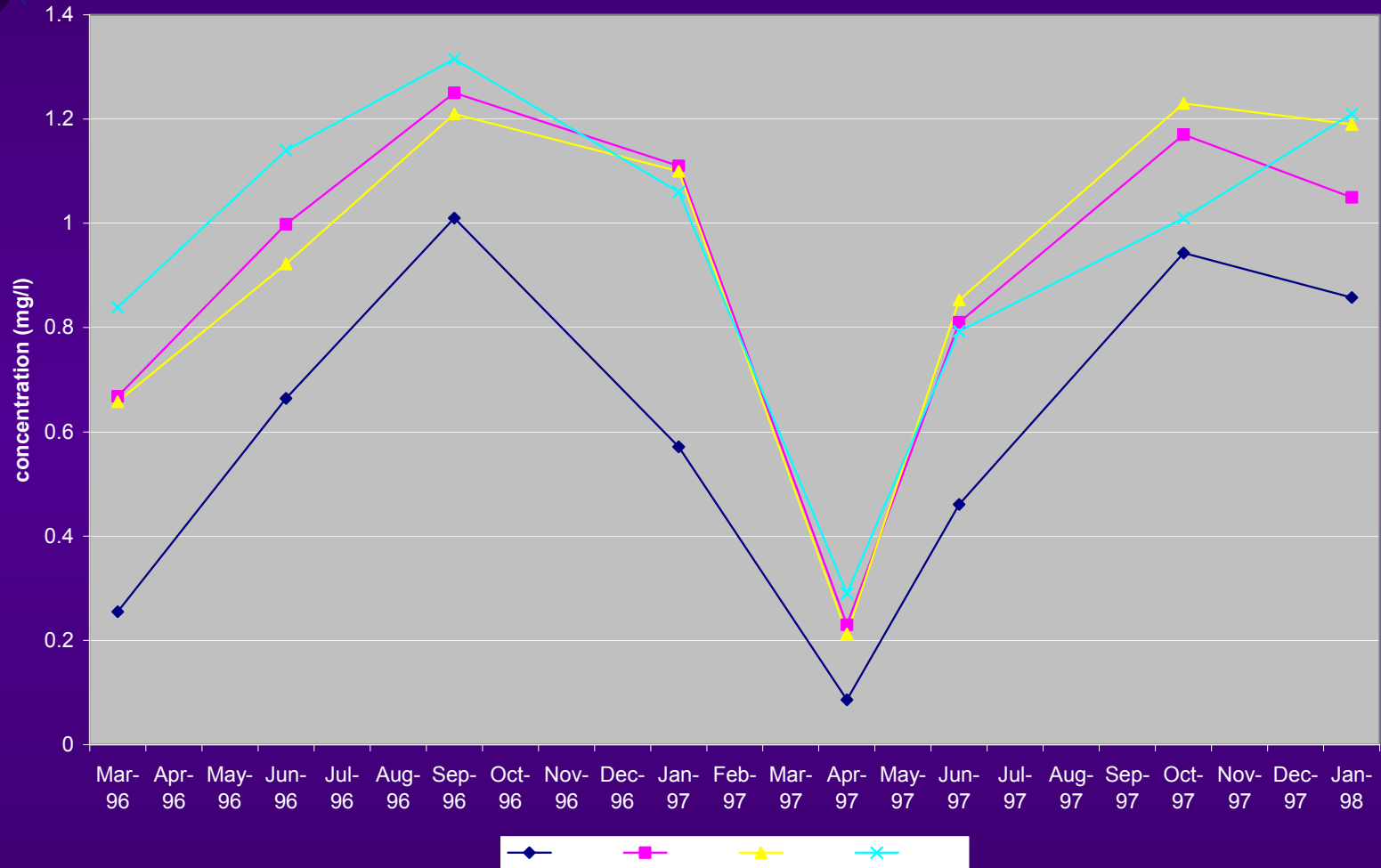


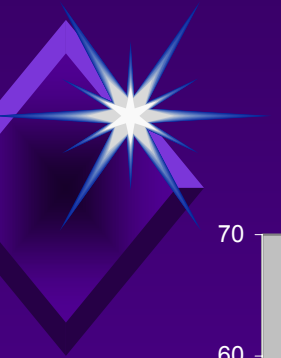
Site O -- Chloride



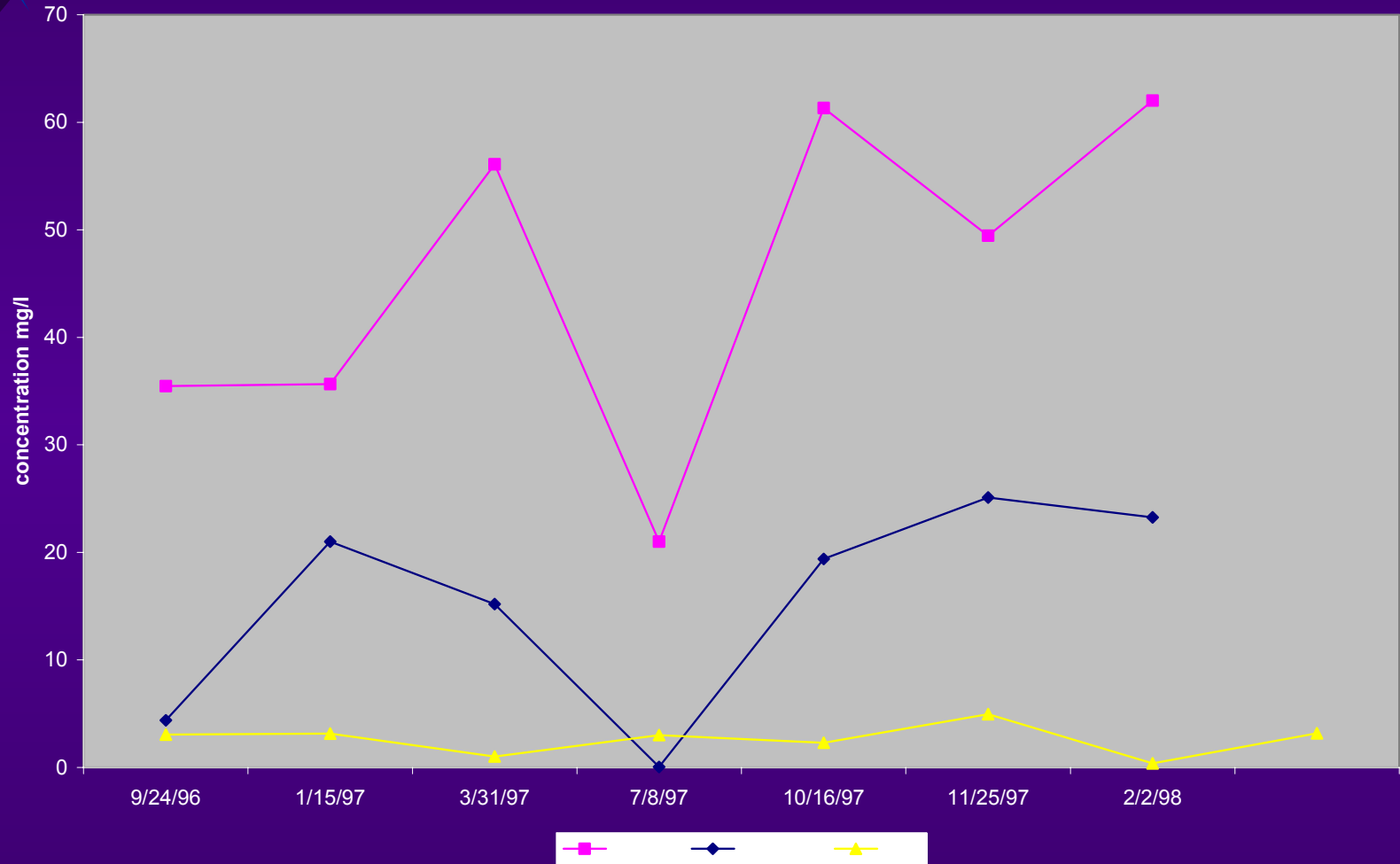


Site O -- Total Nitrogen



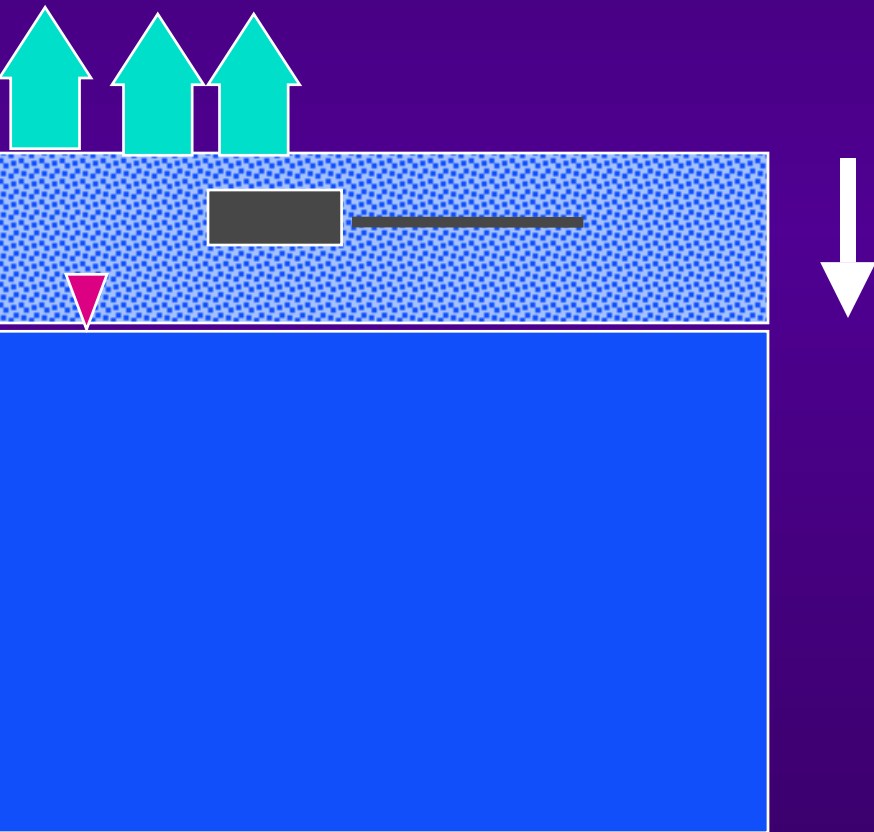


Total Nitrogen

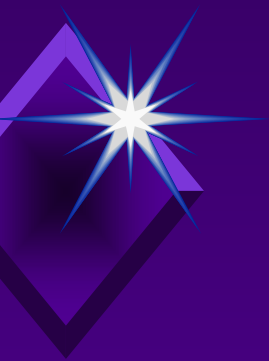




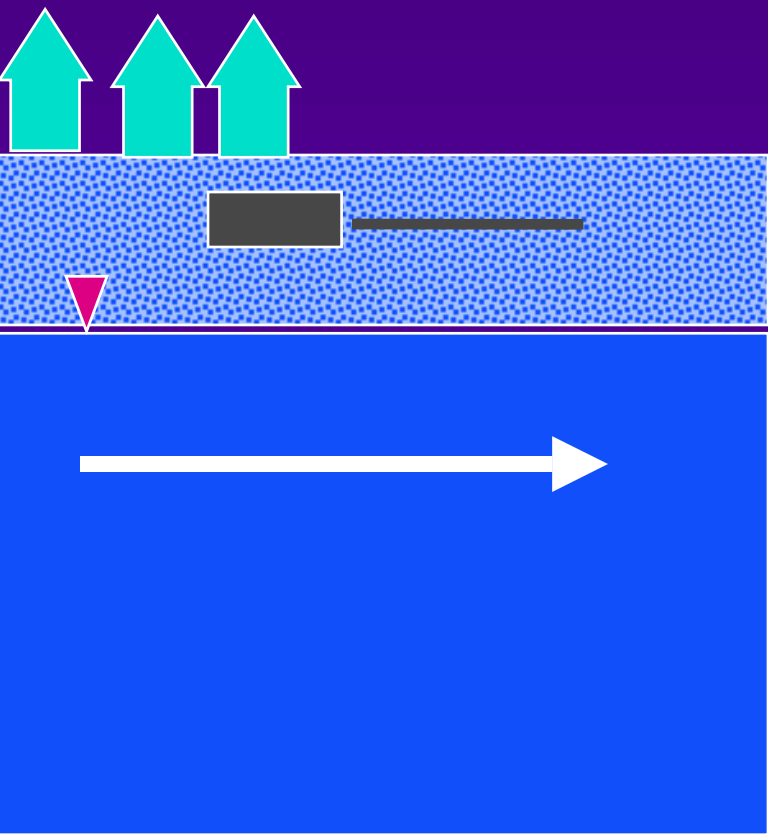
% Contaminant Reduction



	<u>TN</u>	<u>Cl</u>	<u>TDS</u>
effluent			
	50	39	31
lysimeter			
	96	92	77



% Contaminant Increase in Downgradient Wells



<u>NO3</u>	<u>TN</u>	<u>Cl</u>	<u>TDS</u>
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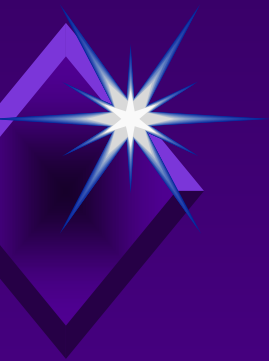
upgradient

0.57	0.61	2.2	57
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42	37	12	3%
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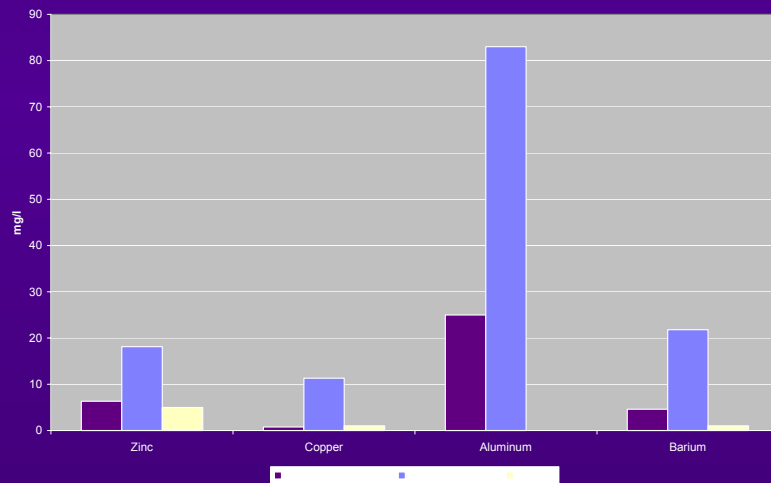
0.99	0.96	2.48	59
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downgradient

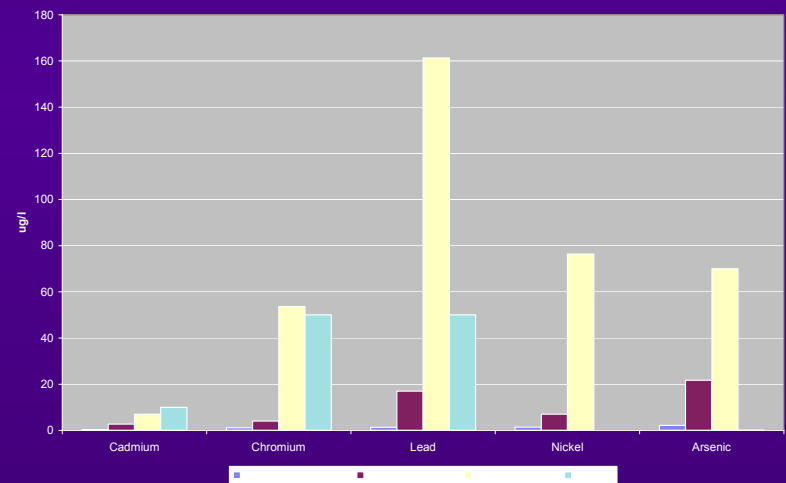


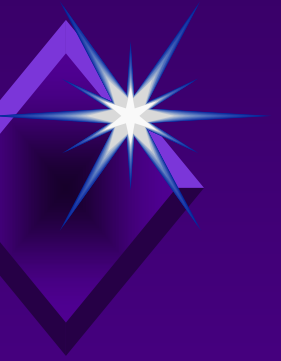
Metals

Metals Concentrations



Metals Concentrations

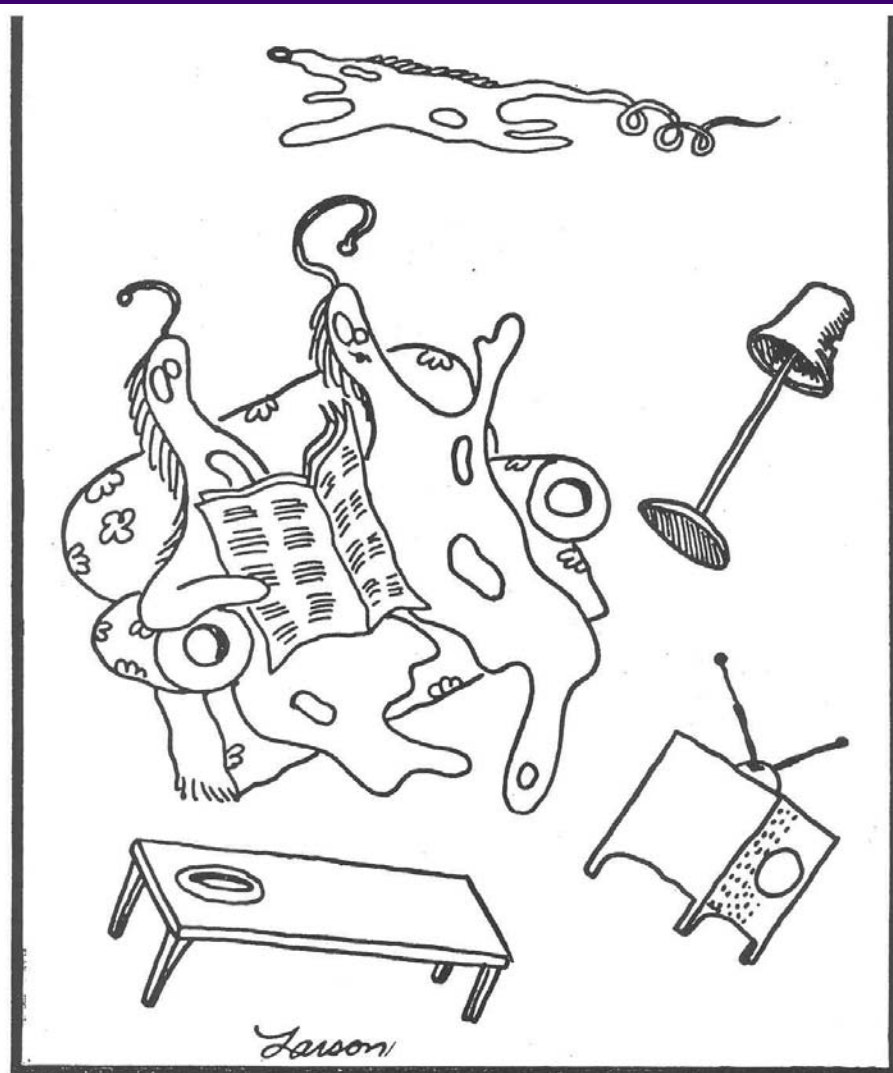
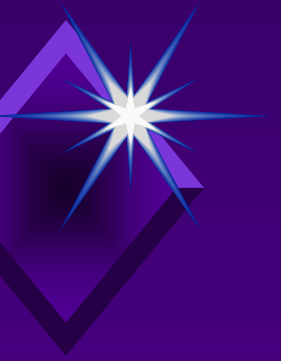




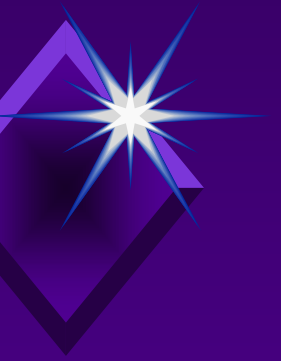
Methylene Blue Activated Substances

- ◆ Indicator of septage
- ◆ By-product of detergents
- ◆ Present in ground water (0.042 mg/l)
- ◆ Soil-pore water (0.188 mg/l)





Things that live in a drop of water, and some of their furniture.



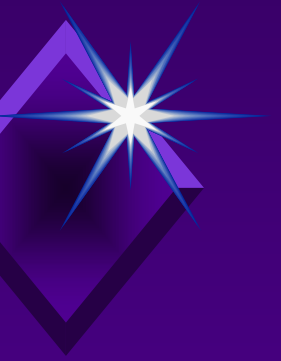
Conclusions

- ◆ On-site sewage systems provide effective treatment of domestic wastewater.....as long as the system is:
 - ◆ appropriately located
 - ◆ designed
 - ◆ constructed, and
 - ◆ maintained



Conclusions

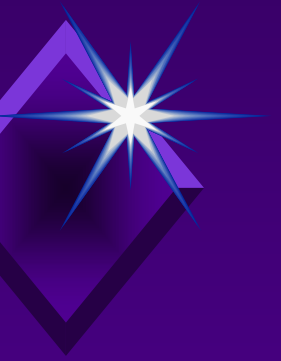
- ◆ Assimilative capacity of ground water is necessary to reduce wastewater concentrations entering ground water to acceptable levels.
- ◆ Contaminant loading should be managed through treatment or by appropriate siting criteria



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